영상처리 Python 실습 과제 3

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Edge detection을 위해서 다음과 같은 python program을 작성하고 실행하여 결과를 관찰하시오.

(a) Edge detection을 하기 위한 python program을 작성하여 lena.png, boats.png 영상에 대해서 실행하고 edge detection을 위한 임계값을 변화시킬 때 결과 영상의 변화를 관찰하시오. (Sobel operator 사용 (x 방향과 y 방향의 sobel operator를 각각 정의하고 ndimage.convolve를 사용하여 x 방향의 gradient와 y 방향의 gradient를 각각 구함)

- Magnitude of gradient

$$g(n_1,n_2) = \{[g_x(n_1,n_2)]^2 + [g_y(n_1,n_2)]^2\}^{1/2}$$

$g(n_1,n_2)$: gradient, $g_x(n_1,n_2)$: x gradient, $g_y(n_1,n_2)$: y gradient

or

$$g(n_1,n_2) = |g_x(n_1,n_2)| + |g_y(n_1,n_2)|$$

- Edge : I_g

$$I_g = \{(n_1,n_2) : g(n_1,n_2) > t\}$$

Sobel $\frac{1}{4}\begin{pmatrix} 1 & 0 & -1 \\ 2 & \underline{0} & -2 \\ 1 & 0 & -1 \end{pmatrix}$ $\frac{1}{4}\begin{pmatrix} -1 & -2 & -1 \\ 0 & \underline{0} & 0 \\ 1 & 2 & 1 \end{pmatrix}$

[그림1 – lena.png]

- Python Code

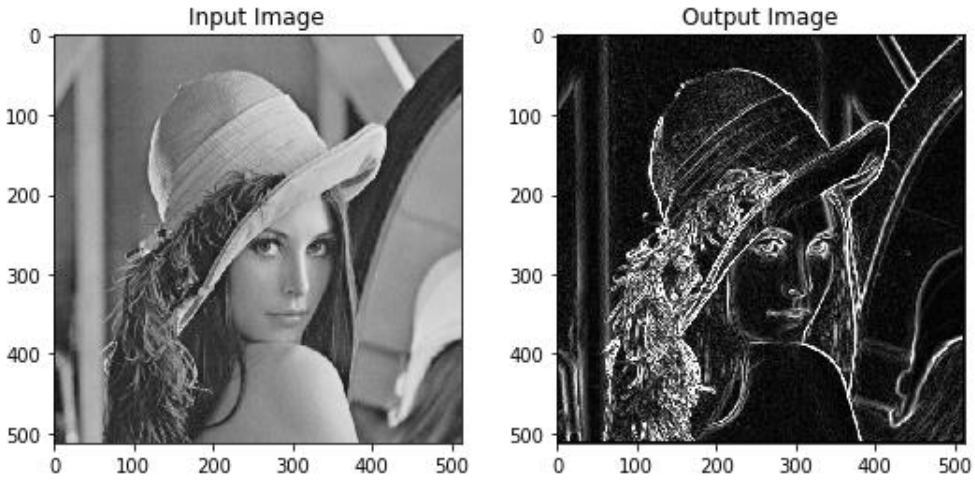
```
import numpy as np
from scipy import ndimage
from matplotlib import pyplot as plt

img = plt.imread('lena.png')
img = np.uint8(255*img)
plt.imshow(img,'gray',vmin=0,vmax=255)
plt.title("Input Image")
plt.show()

# sobel operator
filter_x = np.array([[-1, 0, 1], [-2, 0, 2], [-1, 0, 1]])
filter_y = np.array([[-1, -2, -1], [0, 0, 0], [1, 2, 1]])

h, w = img.shape
```

```
newImage_x = np.zeros((h, w))
newImage_y = np.zeros((h, w))
newgradientImage = np.zeros((h, w))

# define gradient
imgthres = np.zeros([h,w])
for i in range(1, h - 1):
    for j in range(1, w - 1):
       if(img[i,j]>=255):     # 임계값 = 255 인 경우
            imgthres[i,j]=255
       else:
            imgthres[i,j]=0

            gradient_x = (filter_x[0, 0] * img[i - 1, j - 1]) + \
                         (filter_x[0, 1] * img[i - 1, j]) + \
                         (filter_x[0, 2] * img[i - 1, j + 1]) + \
                         (filter_x[1, 0] * img[i, j - 1]) + \
                         (filter_x[1, 1] * img[i, j]) + \
                         (filter_x[1, 2] * img[i, j + 1]) + \
                         (filter_x[2, 0] * img[i + 1, j - 1]) + \
                         (filter_x[2, 1] * img[i + 1, j]) + \
                         (filter_x[2, 2] * img[i + 1, j + 1])
            newImage_x[i - 1, j - 1] = ndimage.convolve(img[i - 1, j - 1], gradient_x)

            gradient_y = (filter_y[0, 0] * img[i - 1, j - 1]) + \
                      (filter_y[0, 1] * img[i - 1, j]) + \
                      (filter_y[0, 2] * img[i - 1, j + 1]) + \
                      (filter_y[1, 0] * img[i, j - 1]) + \
                      (filter_y[1, 1] * img[i, j]) + \
                      (filter_y[1, 2] * img[i, j + 1]) + \
                      (filter_y[2, 0] * img[i + 1, j - 1]) + \
                      (filter_y[2, 1] * img[i + 1, j]) + \
```

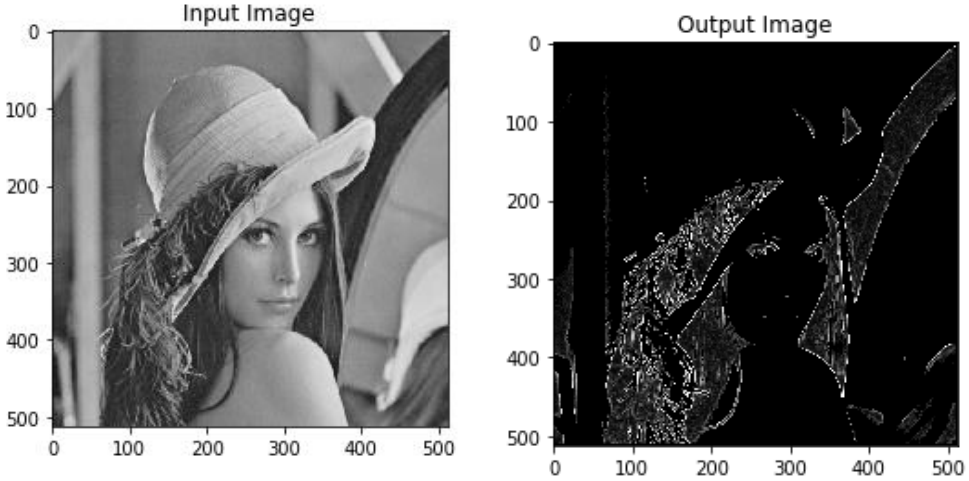
```
                    (filter_y[2, 2] * img[i + 1, j + 1])
            newImage_y[i - 1, j - 1] = ndimage.convolve(img[i - 1, j - 1], gradient_y)

           # Edge Magnitude
            magnitude = np.sqrt(pow(gradient_x, 2.0) + pow(gradient_y, 2.0))
            newgradientImage[i - 1, j - 1] = magnitude

plt.imshow(newgradientImage,'gray',vmin=0,vmax=255)
plt.title("Output Image")
plt.show()
```

- Image

(1) 임계값 = 255



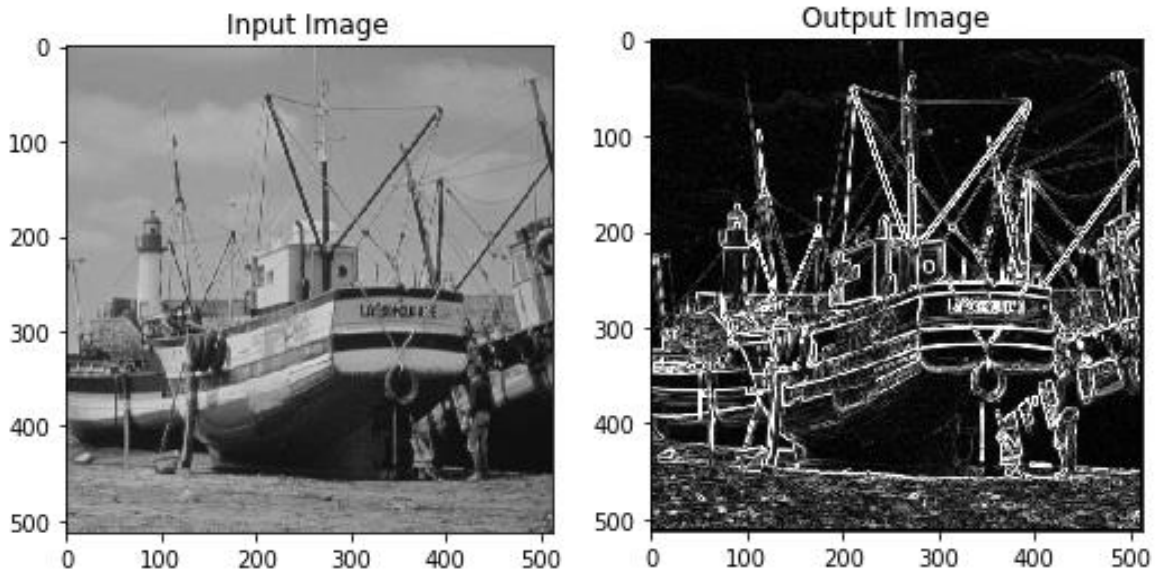
(2) 임계값 = 80



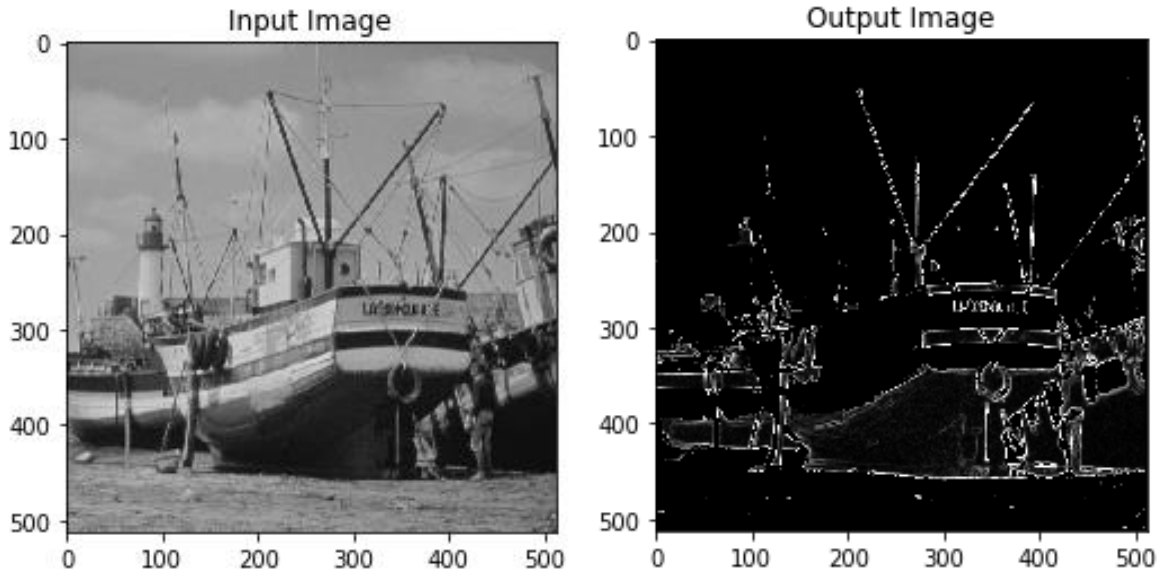
[그림2 – boats.png]

- Image

(1) 임계값 = 255



(2) 임계값 = 80



=> Edge detection을 하기 위한 python program을 lena.png, boats.png 영상에 대해 실행한 결과입니다. 임계값이 커질수록 edge가 더 많이 검출되는 것을 확인하였습니다.

(b) (a)번에서 작성한 program에서 edge detection 부분을 function에서 수행하도록 code를 수정하고 동작을 검증하시오.

- Python Code

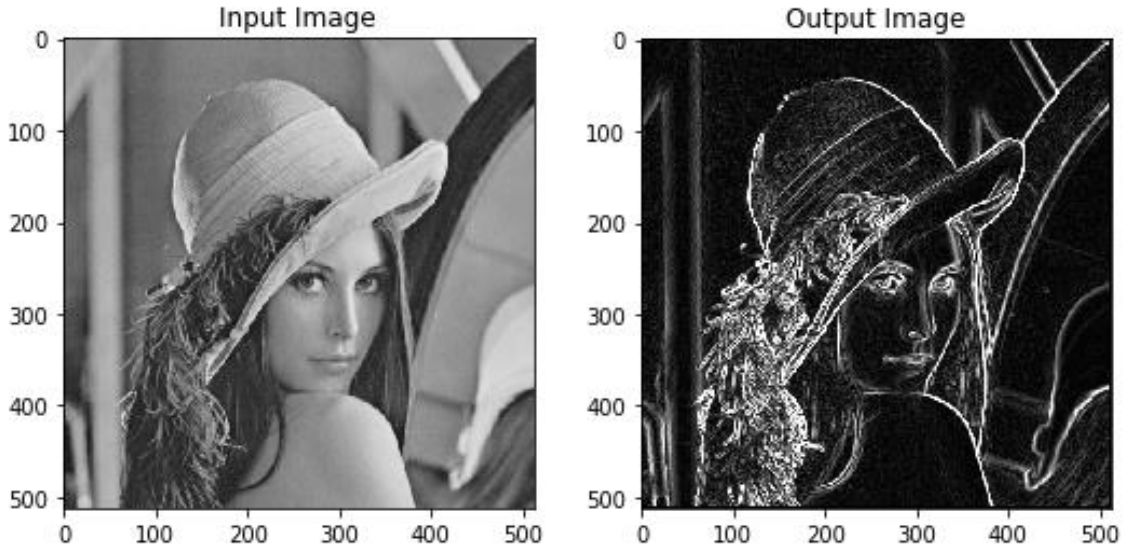
```
import numpy as np
from scipy import ndimage
from matplotlib import pyplot as plt

img = plt.imread('lena.png')
img = np.uint8(255*img)
plt.imshow(img,'gray',vmin=0,vmax=255)
plt.title("Input Image")
plt.show()

# sobel operator
filter_x = np.array([[-1, 0, 1], [-2, 0, 2], [-1, 0, 1]])
filter_y = np.array([[-1, -2, -1], [0, 0, 0], [1, 2, 1]])

h, w = img.shape

newImage_x = np.zeros((h, w))
newImage_y = np.zeros((h, w))
newgradientImage = np.zeros((h, w))

# edge detection function
def edge_fn():
  imgthres = np.zeros([h,w])
  for i in range(1, h - 1):
     for j in range(1, w - 1):
        if(img[i,j]>=255):     # 임계값 변화시키는 부분
            imgthres[i,j]=255
        else:
            imgthres[i,j]=0
```

```
            gradient_x = (filter_x[0, 0] * img[i - 1, j - 1]) + \
                         (filter_x[0, 1] * img[i - 1, j]) + \
                         (filter_x[0, 2] * img[i - 1, j + 1]) + \
                         (filter_x[1, 0] * img[i, j - 1]) + \
                         (filter_x[1, 1] * img[i, j]) + \
                         (filter_x[1, 2] * img[i, j + 1]) + \
                         (filter_x[2, 0] * img[i + 1, j - 1]) + \
                         (filter_x[2, 1] * img[i + 1, j]) + \
                         (filter_x[2, 2] * img[i + 1, j + 1])
            newImage_x[i - 1, j - 1] = ndimage.convolve(img[i - 1, j - 1], gradient_x)

            gradient_y = (filter_y[0, 0] * img[i - 1, j - 1]) + \
                      (filter_y[0, 1] * img[i - 1, j]) + \
                      (filter_y[0, 2] * img[i - 1, j + 1]) + \
                      (filter_y[1, 0] * img[i, j - 1]) + \
                      (filter_y[1, 1] * img[i, j]) + \
                      (filter_y[1, 2] * img[i, j + 1]) + \
                      (filter_y[2, 0] * img[i + 1, j - 1]) + \
                      (filter_y[2, 1] * img[i + 1, j]) + \
                      (filter_y[2, 2] * img[i + 1, j + 1])
            newImage_y[i - 1, j - 1] = ndimage.convolve(img[i - 1, j - 1], gradient_y)

           # Edge Magnitude
            magnitude = np.sqrt(pow(gradient_x, 2.0) + pow(gradient_y, 2.0))
            newgradientImage[i - 1, j - 1] = magnitude

  return imgthres

edge_fn()

plt.imshow(newgradientImage,'gray',vmin=0,vmax=255)
plt.title("Output Image")
```

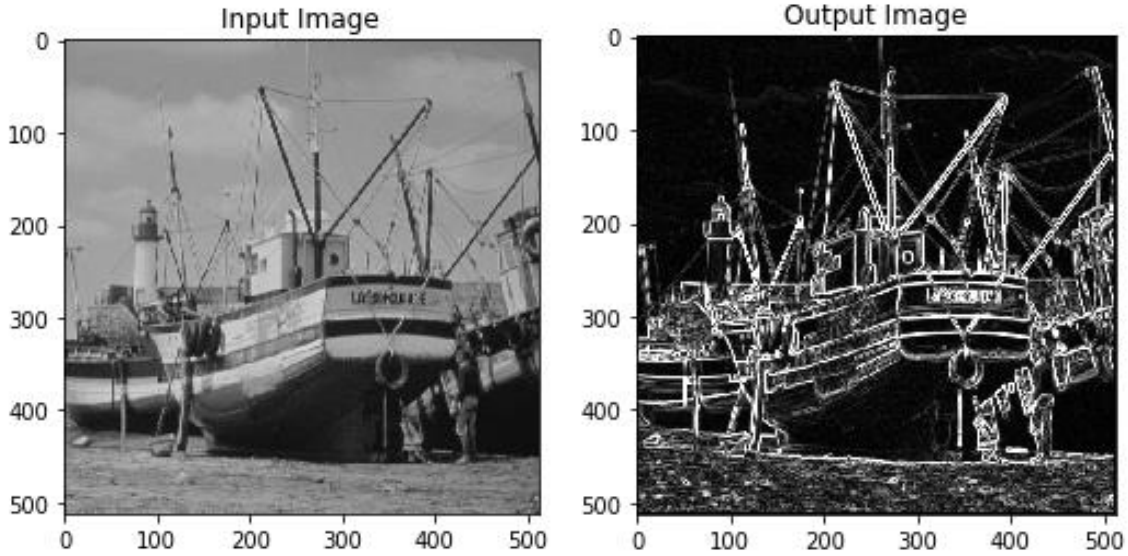
```
plt.show()
```

- Image

(1) lena.png



(2) boats.png



=> 실행결과가 (a)와 같습니다.

(c) (b)번에서 작성한 program에서 edge detection을 위한 function을 별도의 edge_fn.py 분리하여 작성하고 edge detection을 포함하는 file을 module로 import하여 function을 call하는 program으로 수정하여 다시 작성하고(두개의 python code file을 하나의 project로 구성) 실행하여 결과가 (a), (b)와 같은지 검토하시오.

- edge_fn.py

```
import numpy as np
from scipy import ndimage
from matplotlib import pyplot as plt

img = plt.imread('lena.png')
img = np.uint8(255*img)

# sobel operator
filter_x = np.array([[-1, 0, 1], [-2, 0, 2], [-1, 0, 1]])
filter_y = np.array([[-1, -2, -1], [0, 0, 0], [1, 2, 1]])

h, w = img.shape

newImage_x = np.zeros((h, w))
newImage_y = np.zeros((h, w))
newgradientImage = np.zeros((h, w))

# edge detection function
def ed_fn():
  imgthres = np.zeros([h,w])
  for i in range(1, h - 1):
     for j in range(1, w - 1):
        if(img[i,j]>=255):     # 임계값 변화시키는 부분
            imgthres[i,j]=255
        else:
            imgthres[i,j]=0
```

```
            gradient_x = (filter_x[0, 0] * img[i - 1, j - 1]) + \
                         (filter_x[0, 1] * img[i - 1, j]) + \
                         (filter_x[0, 2] * img[i - 1, j + 1]) + \
                         (filter_x[1, 0] * img[i, j - 1]) + \
                         (filter_x[1, 1] * img[i, j]) + \
                         (filter_x[1, 2] * img[i, j + 1]) + \
                         (filter_x[2, 0] * img[i + 1, j - 1]) + \
                         (filter_x[2, 1] * img[i + 1, j]) + \
                         (filter_x[2, 2] * img[i + 1, j + 1])
            newImage_x[i - 1, j - 1] = ndimage.convolve(img[i - 1, j - 1], gradient_x)

            gradient_y = (filter_y[0, 0] * img[i - 1, j - 1]) + \
                      (filter_y[0, 1] * img[i - 1, j]) + \
                      (filter_y[0, 2] * img[i - 1, j + 1]) + \
                      (filter_y[1, 0] * img[i, j - 1]) + \
                      (filter_y[1, 1] * img[i, j]) + \
                      (filter_y[1, 2] * img[i, j + 1]) + \
                      (filter_y[2, 0] * img[i + 1, j - 1]) + \
                      (filter_y[2, 1] * img[i + 1, j]) + \
                      (filter_y[2, 2] * img[i + 1, j + 1])
            newImage_y[i - 1, j - 1] = ndimage.convolve(img[i - 1, j - 1], gradient_y)

           # Edge Magnitude
            magnitude = np.sqrt(pow(gradient_x, 2.0) + pow(gradient_y, 2.0))
            newgradientImage[i - 1, j - 1] = magnitude

  return imgthres
```

- ed_dect_test4.py

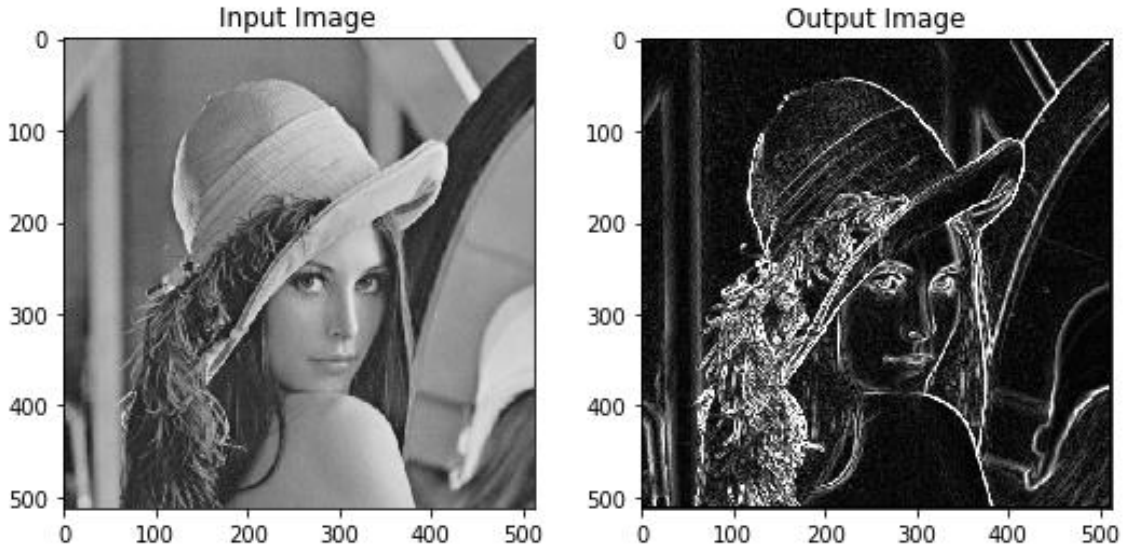
```
import numpy as np
from scipy import ndimage
from matplotlib import pyplot as plt
```

```
from sub1 import edge_fn

img = plt.imread('lena.png')
img = np.uint8(255*img)
plt.imshow(img,'gray',vmin=0,vmax=255)
plt.title("Input Image")
plt.show()

# sobel operator
filter_x = np.array([[-1, 0, 1], [-2, 0, 2], [-1, 0, 1]])
filter_y = np.array([[-1, -2, -1], [0, 0, 0], [1, 2, 1]])

h, w = img.shape

newImage_x = np.zeros((h, w))
newImage_y = np.zeros((h, w))
newgradientImage = np.zeros((h, w))

# edge detection function
def ed_fn():
  imgthres = np.zeros([h,w])
  for i in range(1, h - 1):
     for j in range(1, w - 1):
        if(img[i,j]>=255):     # 임계값 변화시키는 부분
            imgthres[i,j]=255
        else:
            imgthres[i,j]=0

            gradient_x = (filter_x[0, 0] * img[i - 1, j - 1]) + \
                         (filter_x[0, 1] * img[i - 1, j]) + \
                         (filter_x[0, 2] * img[i - 1, j + 1]) + \
                         (filter_x[1, 0] * img[i, j - 1]) + \
                         (filter_x[1, 1] * img[i, j]) + \
```

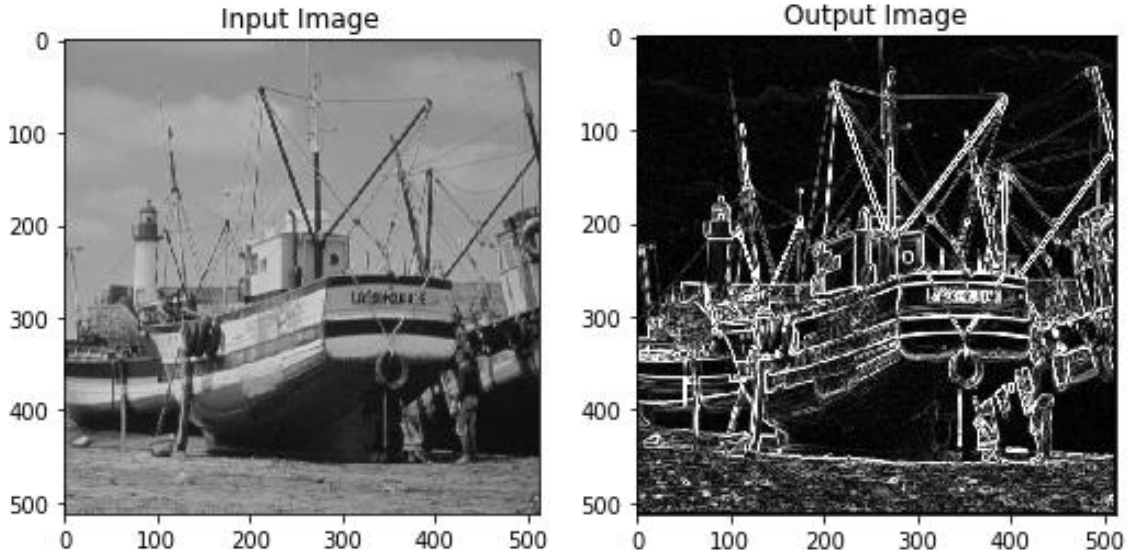
```
                    (filter_x[1, 2] * img[i, j + 1]) + \
                    (filter_x[2, 0] * img[i + 1, j - 1]) + \
                    (filter_x[2, 1] * img[i + 1, j]) + \
                    (filter_x[2, 2] * img[i + 1, j + 1])
            newImage_x[i - 1, j - 1] = ndimage.convolve(img[i - 1, j - 1], gradient_x)

            gradient_y = (filter_y[0, 0] * img[i - 1, j - 1]) + \
                      (filter_y[0, 1] * img[i - 1, j]) + \
                      (filter_y[0, 2] * img[i - 1, j + 1]) + \
                      (filter_y[1, 0] * img[i, j - 1]) + \
                      (filter_y[1, 1] * img[i, j]) + \
                      (filter_y[1, 2] * img[i, j + 1]) + \
                      (filter_y[2, 0] * img[i + 1, j - 1]) + \
                      (filter_y[2, 1] * img[i + 1, j]) + \
                      (filter_y[2, 2] * img[i + 1, j + 1])
            newImage_y[i - 1, j - 1] = ndimage.convolve(img[i - 1, j - 1], gradient_y)

           # Edge Magnitude
            magnitude = np.sqrt(pow(gradient_x, 2.0) + pow(gradient_y, 2.0))
            newgradientImage[i - 1, j - 1] = magnitude

  return imgthres

ed_fn()

plt.imshow(newgradientImage,'gray',vmin=0,vmax=255)
plt.title("Output Image")
plt.show()
```

- Image

(1) lena.png



(2) boats.png



=> 실행결과가 (a), (b)와 같습니다.